AD-A120 833 EVALUATION OF WATER-BORNE LEAD AND CHROMIUM FREE ANTI-CORROSIVE PRIMERS(U) DL LABS NEW YORK S B LEVINSON ET AL. 30 JUL 82 DL-6010 DAAK70-81-C-0100 1/1

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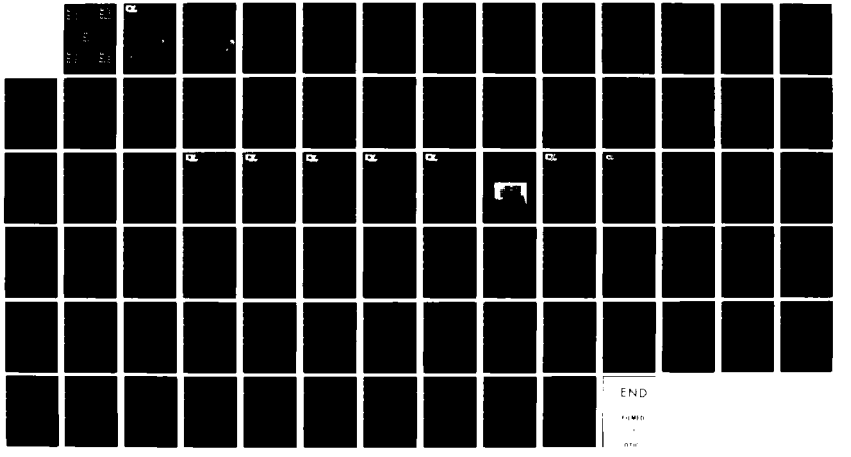

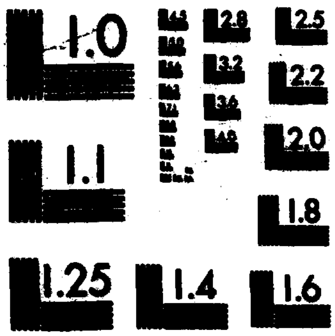

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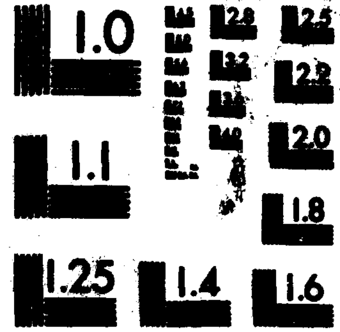

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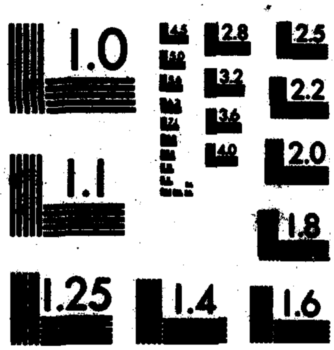

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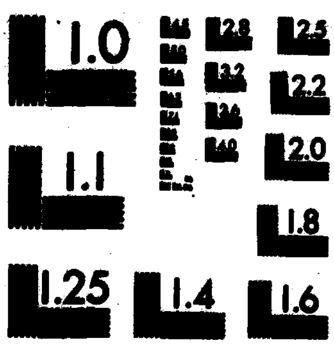

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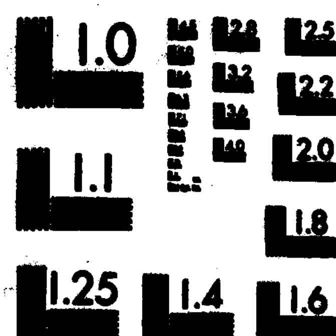

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EVALUATION OF WATER-BORNE LEAD AND CHROMIUM FREE ANTI-CORROSIVE PRIMERS

Contract No. DAAK70-81-0100

Prepared for US ARMY MERADCOM

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July 30, 1982

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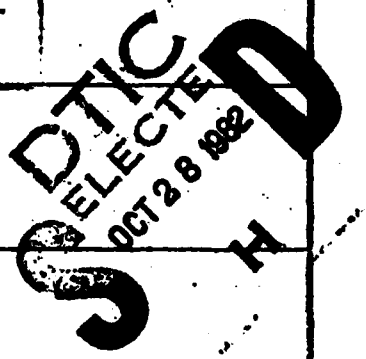

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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Air quality regulation	Lead	Survey
Aluminum	Primer	VOC
Chromium VI	Proprietary	Water-borne
Corrosion resistance	Steel	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

US AMERADCOM is striving to replace primers used on Army Equipment with low VOC coatings in order to meet air quality regulations and to eliminate lead and Chromium VI. 35 water-borne, lead and chromium-free formulations and proprietary primers were evaluated. One formulation and one proprietary primer are almost equal to TT-P-1757 in corrosion resistance. Another formulation and two proprietary primers are acceptable with minor modifications. Six other formulations and one proprietary primer are acceptable for use on aluminum but not on steel.

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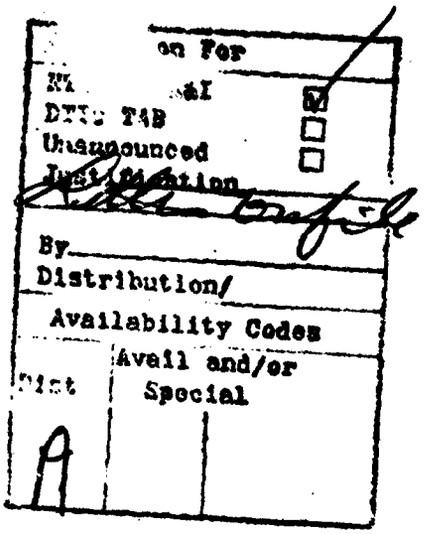
FOREWARD

US AMERADCOM is striving to replace the metal primers presently used on Army equipment in order to meet present or anticipated air regulations issued to reduce air pollution from volatile organic compounds, and to eliminate toxic corrosion-inhibiting pigments. Therefore, this program was instituted to locate and evaluate water-borne metal primers free of toxic pigments.

A survey of the industry resulted in the submission of 35 candidate formulations and/or primers. The result of the evaluation conducted demonstrated that none of the products prepared and tested are exactly equal to TT-P-1757 "Primer Coating, Zinc Chromate, Low Moisture-Sensitivity" in corrosion resistance. However, one formulation and one proprietary primer are almost equal to TT-P-1757 in performance. In addition, one formulation and two proprietary primers exhibit acceptable performance but require some modification to improve storage stability. On the other hand, six formulations and one proprietary primer are acceptable for use on aluminum but not on steel.



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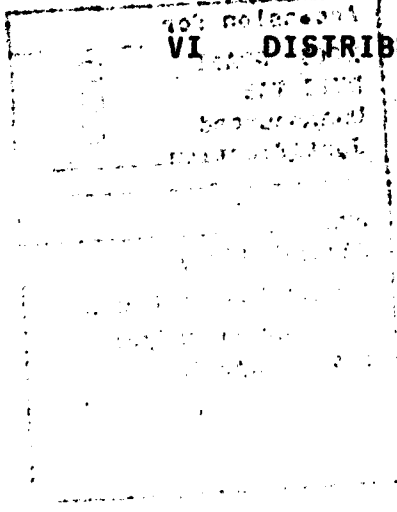

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LIST OF TABLES

I INTRODUCTION

A. BACKGROUND

The paints and coatings used on steel and aluminum Army equip- usually consist of two essential types of products: an anti-corrosive primer applied directly on the metal substrate and a topcoat. The primer is used to assure adhesion to the substrate and to prevent corrosion. The topcoat is used to provide the desired appearance, e.g. camouflage, and to protect the primer from the weather, fuel spills, abrasion, etc.

The primers presently used contain volatile organic solvents, including aliphatic or aromatic hydrocarbons, which serve a number of important functions. They reduce viscosity to enable proper and rapid application, e.g., by spray, to improve wetting and thus assure ultimate adhesion to the substrate, and to improve leveling thus producing a smooth paint film free of defects such as orange peel, runs, etc.

These primers develop their corrosion resistance from the use of corrosion-inhibiting pigments. The most effective anti-corrosive pigments presently used are based either on lead or Chromium VI, both of which are toxic.

Because of the increased concern regarding health and safety, as well as both current and anticipated governmental regulations to control pollution of the environment by volatile organic compounds, there is a need for the development of water-borne corrosion-inhibiting primers that are also free of toxic pigments, such as those containing lead and Chromium VI. However, neither the desired formulations nor the data required to confirm their utility for Army equipment are readily available.

Consequently, it was necessary to determine the latest technology on this subject, locate candidate formulations and raw materials, prepare these formulations and evaluate their performance vs the important properties desired for this end use.

B. OBJECTIVE

The purpose of this program was to formulate and evaluate lead and Chromium VI-free, water-borne corrosion-inhibiting primers that can be applied on both ferrous and aluminum substrates. These primers should be as corrosion resistant as the organic solvent-thinned primers presently used, in order to have the potential of replacing the latter for use on Army mobility equipment.

C. REQUIREMENTS

The primers to be formulated should meet the following requirements:

1. They should contain no lead or Chromium VI.

2. They should contain a maximum of 3.5 lbs/gal (420 gms/liter) of volatile organic compounds (VOC) as applied.

3. The solvents in the primers should be exempt, i.e., they should conform to Rule 66 or Rule 102 of the Southern California Air Pollution Control District (SCAPCD).

4. The polymers in the primers may be either water emulsifiable or water soluble. They should be based on acrylic, alkyd, epoxy, urethane or butadiene-styrene polymers or modified polymers.

These primers should also meet the following physical and performance requirements:

1. Acceptable package stability after accelerated storage of four weeks at 125°F.

2. Good freeze-thaw stability.

3. A flash point of at least 100°F.

4. Thinnable with water to both brush and spray viscosities.

5. Applicable by conventional equipment.

6. Air dry tack-free within 6 hours.

7. Show no flash rusting when applied.

8. Pass a 144 hour exposure to salt fog.

II TECHNICAL APPROACH

A. SURVEY

The first step was to publicize the interest of US AMERADCOM and thus encourage submission of recommended formulations and raw materials. This was done by distributing a Publicity Release to all of the major Paint and Coaings publications as well as Chemical Week and Chemical and Engineering News. See Appendix A1 and A2.

The second step was to write directly to the major suppliers of polymers, non-toxic corrosion-inhibiting pigments and additives, e.g. adhesion promotors and rust-preventive compounds. See Appendix A3 thru A5.

A third step was to publicize the program by a display at the D/L Laboratories booth in the Paint Industries Show at the Annual Paint And Coatings Convention in Detroit, Michigan, October 28 - 30, 1981. See Appendix A-6.

B. LITERATURE SEARCH

All major paint and coatings publications for the past five years were reviewed to obtain recommendations on formulating primers to meet the above criteria.

C. PROPRIETARY PRIMERS

One result of the survey was the offer by many paint and coating manufacturers to submit proprietary primers for the test program.

This was discussed with the CTR and it was decided to modify the program to allow the inclusion of proprietary, as well as formulated primers, and thus improve the potential for obtaining acceptable products which would meet the criteria. All suppliers were advised that they would have to submit an analysis if their products were accepted as candidates and were assured that such information would be kept strictly confidential. See Appendix A-7. A-7.

D. PRODUCTS TESTED

A total of 35 apparently acceptable formulations or primers were selected for test. They are as follows:

15 Formulations

9* Primers submitted (with formulations) by raw material suppliers

11 Proprietary primers

The products tested are listed in Table II-1. The formulations are shown in Appendix C and the complete names, addresses and contacts for the suppliers are listed in Appendix D.

* One primer (S-9) was rejected because of an excess concentration of VOC.

E. TEST PROGRAM

1. Data Review and Product Selection

A considerable amount of data, as well as formulations, were received from raw material suppliers, both those surveyed and in answer to the publicity and display at the D/L Laboratories booth in the Paint Industries Show. In addition, many paint manufacturers offered to submit proprietary primers which had not been considered originally.

These were reviewed carefully in order to choose formulations which met the analytical criteria, primarily for the absence of lead and Chromium VI compounds, VOC concentrations below 3.5 lbs per gal. of paint and the potential of meeting the physical and performance criteria.

Inasmuch as the paint manufacturers could not be expected to divulge the formulations of their primers, they were asked to confirm that their products met the criteria, with the understanding that the VOC would be determined by the D/L Laboratories and that the analyses of their products would be divulged to AMERADCOM under a confidentiality agreement.

2. Paint Preparation

Samples of the raw materials required to prepare the acceptable formulations were obtained and these formulations were prepared. However, nine raw material suppliers offered to prepare their formulations and submit the finished primers. Their offers were accepted as a means of increasing the total number of formulations which could be evaluated within the financial limitations of the contract.

3. Test Procedure

The following properties were tested. The test methods used are described in Appendix E.

1.	VOC	ASTM D-3960
2.	Weight per Gallon	ASTM D-1475
3.	Total Solids	ASTM D-2832
4.	Flash Point	ASTM D-93

5.	Viscosity	ASTM D-562
	Initial	
	4 weeks at 125°F	ASTM D-1849
	Freeze-thaw	ASTM D-2243
6.	Storage Stability	ASTM D-1849
	Liquid separation	
	Skinning	
	Pigment settling	
	Ease of remixing	
7.	Speed of Dry	ASTM D-1640
	Set to touch	
	Dry tack free	
	Dry hard	
	Dry thru	
8.	Sprayability	Federal 141B, Method 4331
9.	Brushability	Federal 141B, Method 4321
10.	Adhesion To -	
	-Bonderized steel	Federal TT-P-141B
	-Aluminum	Method 6304
11.	Salt Fog Exposure - 144 hours	ASTM B-117

a) Applied on Bonderized steel at 1.0 mil dft
b) Ditto at 1.5 mils dft
c) Applied on aluminum at 1.0 mil dft
d) Ditto at 1.5 mils dft

Record -

(1) Blistering - at X score
(2) - overall
(3) Corrosion - at X score
(4) - overall

dft - dry film thickness

TABLE II-1 PRIMERS TESTED

Code	Number	Supplier
Prepared Formulations		
F-1	FX-8	Buckman Laboratories
F-2	P-1686-116-3	Cargill
F-3	5727 C	Halox Pigments
F-4	7585 D	Halox Pigments
F-5	None	Mineral Pigments
F-7	137-68	PVO International
F-8	PWB-76	Reichard Coulston
F-9	KK-1006-7A	Reichard Coulston
F-10	1855-32A	Spencer Kellogg
F-11	2007-10-1	Spencer Kellogg
F-12	RM-3	Wet Ground Mica Association
F-13	RN-3	Wet Ground Mica Association
F-14	30708-2	Celanese
F-15	30708-3	Celanese
F-16	30708-4	Celanese
Submitted Formulations		
S-1	CAS 1795	Rohm and Haas
S-2	ESA 1136	Rohm and Haas
S-3	ESA 1252-3	Rohm and Haas
S-4	ESA 1255-1	Rohm and Haas
S-5	FL 2915	Rohm and Haas
S-6	Haloflex 202 Primer	ICI Americas
S-7	191	Polyvinyl Chemical
S-8	14JG-74A	Union Carbide

TABLE II-1 PRIMERS TESTED (Cont)

Code	Number	Supplier
Proprietary Primers		
M-1	931-R-4901	Fuller O'Brien
M-2	Quick Dry Latex Primer	DeVoe Marine
M-3	White Latex Primer	DeVoe Marine
M-4	DeV-258 Red	DeVoe Marine
M-5	DeV-259 White	DeVoe Marine
M-6	SA7981-G73	Sherwin-Williams
M-7	SA8367-G73	Sherwin-Williams
M-8	C-1501	General Electric
M-9	Rustex	Advanced Paint
M-10	Primer W	Advanced Paint
M-11	99X-0106 Gray	Stanchem

The full names and addresses of the suppliers are shown in Appendix D.

III TEST RESULTS AND DISCUSSION

A. TEST RESULTS

The test data are shown in the following Appendices:

B-1 Formulated Primers

B-2 Primers Submitted by Raw Material Suppliers

B-3 Proprietary Primers

B. VOC

The first test conducted was for volatile organic compounds (VOC). Only one product failed - No. S-9, Formulation D-30901 of Lorcon Chemical. It had a VOC of 440 gms/liter (3.7 lbs/gal).

C. SALT FOG EXPOSURE

Inasmuch as salt fog (corrosion) resistance is of paramount importance, the evaluation program was modified, at the request of the CTR, to not only test all formulations and proprietary primers submitted but to also do so on panels prepared at two film thicknesses (1.0 and 1.5 mils dry film thickness) and on two substrates (Bonderized steel and aluminum). TT-P-1757 "Primer Coating, Zinc Chromate, Low-Moisture-Sensitivity" was used as the control.

Additionally, the original scope of the contract was further modified to include painted panels of all coatings applied on both metals and at both film thicknesses to be submitted to the CTR for test at the AMERADCOM laboratories.

All exposure tests were conducted in duplicate. All panels were scored with an "X" covering the bottom half of each panel.

D. DISCUSSION OF RESULTS

The primers tested can be rated for acceptibility by rating their performance using the criteria listed in the introduction. However, because of the problem inherent in this new technology, namely to readily match the performance of conventional metal primers, a marginal category has been added, in which the performance of the primer is just below the desired level.

The criteria used in rating the primers are shown in Table III-1 and the ratings, both Acceptable and Marginal, are shown in the following tables:

III-2 Data Analysis - Formulated Primers

III-3 Data Analysis - Primers Submitted by RM Suppliers

III-4 Data Analysis - Proprietary Primers

TABLE III-I CRITERIA

	Property	Acceptable	Marginal
1	VOC	Below 420 gm/liter or 3.5 lbs/gal	-
2	Flash Point	100°F+	
3	Viscosity	60-100 KU	Below 60, 100-130 KU
4	Viscosity Stability (Heat or Freeze Test)	Maximum change - below 40 KU	Max. = Above 40 KU but no solidification or coagulation
5	Storage Stability	Score of 6+ for all observations	Score of 4 for all observations
6	Speed of Dry	6 hours max. for all tests	Tack free - - 6 hours max. Dry hard - O/N Dry thru - O/N
7	Sprayability	Score of 6+	Score of 4
8	Brushability	Score of 6+	Score of 4
9	Adhesion	Score of 10	Score of 8
10	Salt Fog Resistance		
	Blistering	Max. - 8F or 9M	Max. - 6F or 8M
	Corrosion	Score of 8+	Score of 6+

10 = Perfect
8 = Very good
6 = Good
4 = Fair

O/N - Overnight

Note: Weight per Gallon and Total Solids have not been included as criteria since they are production control tests and therefore of no significance in rating the performance of these products.

The following information is not shown in these tables:

1. Lead and Chromium VI Compounds - Any formulation found to contain either was rejected immediately and not tested. All proprietary primers tested are claimed to have neither.

2. Weight per Gallon - This is used primarily as a production control check and should have no effect on performance.

3. Total Solids - The same applies to this determination.

The following properties are of relatively minor importance and are so noted in the tables:

1. Viscosity - This of relatively minor importance provided that other properties are not adversely affected, e.g., excessive pigment settling, if viscosity is to low, or hard brushing, if viscosity is too high.

2. Accelerated viscosity and storage stability - The test is considered to be equivalent to at least six months of storage. Normally, industrial coatings are used essentially as soon as received so that long term storage is not a serious problem.

3. Freeze-thaw Stability - Water thinned coatings should be shipped and stored in controlled environments to prevent the possibility of freezing.

4. Brushability - These coatings are normally sprayed so that brushability is not critical.

TABLE III-2 DATA ANALYSIS-FORMULATED PRIMERS

	F-1	F-2	F-3	F-4	F-5	F-7	F-8	Minor
VOC	A	A	A	A	A	A	A	
Flash Point	A	A	A	A	A	A	A	
Viscosity	A	M	M	M	A	A	A	xx
Stability-Heat test	F	F	A	A	A	A	A	xx
" -Freeze thaw	F	A	A	A	A	F	A	xx
Storage Stability	F	F	A	A	A	F	M	xx
Speed of Dry	A	A	A	A	A	F	A	
Sprayability	A	A	A	A	X	A	A	
Brushability	A	M	F	A	A	A	A	xx
Adhesion To -								
- Steel	A	A	A	A	X	A	A	
- Aluminum	A	A	A	A	X	A	A	
Salt Fog Resistance								
Steel								
1.0 mil dft	F	M	M	A	X	F	F	
1.5 mil dft	F	M	M	A	X	M	F	
Aluminum								
1.0 mil dft	A	A	M	A	X	A	A	
1.5 mil dft	A	A	A	A	X	A	A	

A - Acceptable
M - Marginal
F - Failed

X - Not tested due to flash rusting on steel
xx - Property of relatively minor importance
dft - Dry film thickness

TABLE III-2 DATA ANALYSIS-FORMULATED PRIMERS

	F-9	F-10	F-11	F-12	F-13	F-14	F-15	F-16	Minor
VOC	A	A	A	A	A	A	A	A	
Flash Point	A	A	A	A	A	A	A		
Viscosity	A	M	A	A	A	A	A	F	xx
Stability-Heat test	F	F	F	M	M	F	A	F	xx
" -Freeze thaw	A	A	A	A	A	A	A	A	xx
Storage Stability	F	F	F	F	A	F	A	F	xx
Speed of Dry	A	A	F	A	A	M	M	M	
Sprayability	A	A	A	A	A	A	A	A	
Brushability	A	A	A	A	A	A	A	A	xx
Adhesion To -									
- Steel	A	A	A	A	A	A	A	A	
- Aluminum	A	A	A	A	A	A	A	A	
Salt Fog Resistance									
Steel									
1.0 mil dft	F	M	M	F	M	M	A	M	
1.5 mil dft	F	F	A	M	F	A	A	A	
Aluminum									
1.0 mil dft	A	F	A	A	A	A	A	A	
1.5 mil dft	A	F	A	A	A	A	A	A	

TABLE III-3 DATA ANALYSIS SUBMITTED BY RM SUPPLIERS

	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	Minor
VOC	A	A	A	A	A	A	A	A	
Flash Point	A	A	A	A	A	A	A	A	
Viscosity	A	M	M	F	M	A	M	A	xx
Stability-Heat test	M	A	A	A	A	A	A	A	xx
" -Freeze thaw	F	A	A	A	A	F	F	A	xx
Storage Stability	F	F	A	F	A	A	F	A	xx
Speed of Dry	A	A	A	A	A	A	A	A	
Sprayability	A	A	A	A	A	A	A	A	
Brushability	A	A	A	A	A	A	A	A	xx
Adhesion To -									
- Steel	A	A	A	A	A	A	A	A	
- Aluminum	A	A	A	A	A	A	A	A	
Salt Fog Resistance									
Steel									
1.0 mil dft	F	F	F	M	F	F	M	F	
1.5 mil dft	F	A	M	A	F	F	M	F	
Aluminum									
1.0 mil dft	A	A	A	A	A	A	M	A	
1.5 mil dft	A	A	A	A	A	A	A	A	

TABLE III-4 DATA ANALYSIS - PROPRIETARY PRIMERS

	M-1	M-2	M-3	M-4	M-5	Minor
VOC	A	A	A	A	A	
Flash Point	A	A	A	A	F	
Viscosity	M	A	A	A	M	xx
Stability - Heat test	A	A	A	M	M	xx
" - Freeze thaw	F	F	M	A	A	xx
Storage Stability	F	M	F	A	A	xx
Speed of Dry	A	A	A	X	F	
Sprayability	A	A	A	A	A	
Brushability	A	A	A	A	A	xx
Adhesion To -						
- Steel	A	A	A	A	A	
- Aluminum	A	A	A	A	A	
Salt Fog Resistance						
Steel						
1.0 mil dft	M	F	F	X	F	
1.5 mil dft	M	F	F	X	F	
Aluminum						
1.0 mil dft	A	F*	A	X	A	
1.5 mil dft	A	F*	A	X	A	

X - Not tested due to extreme grit
* - Panels pitted due to low pH

TABLE III-4 DATA ANALYSIS - PROPRIETARY PRIMERS

	M-6	M-7	M-8	M-9	M-10	M-11	Minor
VOC	A	A	A	A	A	A	
Flash Point	A	A	A	F	A	A	
Viscosity	A	A	M	A	A	A	xx
Stability - Heat test	F	F	A	A	A	A	xx
" - Freeze thaw	A	A	A	-	A	F	xx
Storage Stability	F	F	A	M	A	A	xx
Speed of Dry	A	A	A	F	A	A	
Sprayability	A	A	A	A	A	A	
Brushability	A	A	A	A	F	A	xx
Adhesion To -							
- Steel	A	A	A	A	A	A	
- Aluminum	A	A	A	A	A	A	
Salt Fog Resistance							
Steel							
1.0 mil dft	A	A	A	F	F	F	
1.5 mil dft	A	A	A	A	F	F	
Aluminum							
1.0	A	A	A	A	F	A	
1.5 mil dft	A	A	A	A	M	A	

- Not applicable, solvent-thinned

IV CONCLUSIONS

The following conclusions may be drawn from the results of the evaluation. Note that the deficiencies observed for each primer tested are also included. They are listed by group, in order of corrosion resistance, and numerically within groups:

1. The following primers are the best of all tested and essentially meet the corrosion resistance requirements of TT-P-1757:

   F-4, No. 7585D — Haolx Pigments
   Slightly high viscosity

   F-15, No. 30708-3 — Celanese Chemicals
   Slightly slow drying speed

   M-6, No. SA7981-G73 — Sherwin-Williams
   Fails accelerated heat storage test - a minor deficiency.

   M-7, No. SA8367-G73 — Sherwin-Williams
   Same as M-6

   M-8, No. C-1501 — General Electric Co.
   Slightly low viscosity

2. The following primers exhibit acceptable corrosion resistance when used on aluminum and marginal corrosion resistance when used on steel:

   F-2, No. P-1686-116-3 — Cargill
   Slightly high viscosity, fails heat storage and brushing tests, both of which are minor deficiencies.

   F-14, No. 30708-2 — Celanese Chemicals
   Fails heat storage test, a minor deficiency, and slightly slow dry.

   F-16, No. 30708-4 — Celanese Chemicals
   High viscosity and fails heat storage tests, both minor deficiencies, slightly slow dry.

   S-4, No. ESA 1255-1 — Rohm and Haas
   High viscosity and fails storage stability test, both minor deficiencies.

M-1, No. 931-R-4901 Fuller O'Brien

Slightly low viscosity, fails freeze-thaw and storage stability tests, all minor deficiencies.

3. The following primers exhibit acceptable corrosion resistance when used on aluminum but fail when used on steel:

F-1, No. FX-8 Buckman Laboratories

Fails accelerated heat storage and freeze-thaw tests, both minor deficiencies.

F-8, No. PWB-76 Reichard Coulston

Marginal storage stability, a minor deficiency.

F-9, No. KK-1006-7A Reichard Coulston

Fails accelerated heat storage test, a minor deficiency.

F-12, No. RM-3 Wet Ground Mica Assoc.

Same as F-9 above.

F-13, No. RN-3 Wet Ground Mica Assoc.

Marginal heat storage stability, a minor deficiency.

S-1, No. CAS 1795 Rohm and Haas

Fails accelerated heat storage and freeze-thaw tests, both minor deficiencies.

S-2, No. ESA 1136 Rohm and Haas

Slightly high viscosity and fails storage stability test, both minor deficiencies.

S-3, No. ESA 1252-3 Rohm and Haas

Slightly high viscosity, a minor deficiency.

S-5, No. FL 2915 Rohm and Haas

Same as S-3 above.

S-6, Haloflex 202 Primer ICI Americas

Fails freeze-thaw, a minor deficiency.

S-8, No. 14JG-74A Union Carbide

No other defects.

M-3, White Latex Primer — DeVoe Marine

Marginal freeze-thaw resistance and fails storage stability test, both minor deficiencies.

M-11, No 99X-0106 Gray — Stanchem

Fails freeze-thaw, a minor deficiency.

4. The following primers exhibit marginal corrosion resistance when applied on either steel or aluminum:

F-3, No. 5727c — Halox Pigments

Slightly high viscosity and hard brushing, both minor deficiencies.

S-7, No. 191 — Polyvinyl Chemical

Slightly high viscosity and fails freeze-thaw and storage stability tests, all minor deficiencies.

5. The following primers are not acceptable because of serious deficiencies:

F-5, No number — Mineral Pigments

Excessive flash rusting

F-7, No. 137-68 — PVO International

Very slow drying

F-10, No. 1855-32A — Spencer Kellogg

Poor corrosion resistance when applied on either steel or aluminum.

F-11, No. 2007-10-1 — Spencer Kellogg

Very slow drying

M-2, Quick Dry Latex Primer — DeVoe Marine

Poor corrosion resistance when applied on either steel or aluminum.

M-4, DeV-258 Red — DeVoe Marine

Extremely gritty

M-5, DeV-259 White — DeVoe Marine

Low flash point, very slow drying

M-9, Rustex — Advanced Paint

Low flash point, very slow drying.

M-10, Primer W — Advanced Paint

Poor corrosion resistance when applied on either steel or aluminum.

6. The major problem, overall, is adequate corrosion resistance when applied on steel. The second major problem is excessive change in viscosity or coagulation during the accelerated storage test, either hot or cold. All other deficiencies are relatively minor or scattered.

V RECOMMENDATIONS

The following recommendations are offered to exploit the favorable results of this investigation and to continue efforts where there is a potential of improving the results obtained:

1. Conduct field tests on the following 5 primers applied on both steel and aluminum:

F-4,	No. 7585D	Halox Pigments
F-15,	No. 30708-3	Celanese Chemicals
M-6,	No. SA7981-G73	Sherwin-Williams Co.
M-7,	No. SA8367-G73	Sherwin-Williams Co.
M-8,	No. C-1501	General Electric Co.

2. Conduct field tests on the following 18 primers for use on aluminum substrates only:

F-1	No. FX-8	Buckman Laboratories
F-2	No. P-1686-116-3	Cargill
F-8	No. PWP-76	Reichard Coulston
F-9	No. KK-1006-7A	Reichard Coulston
F-12	No. RM-3	Wet Ground Mica Assoc.
F-13	No. RN-3	Wet Ground Mica Assoc.
F-14	No. 30708-2	Celanese Chemicals
F-16	No. 30708-4	Celanese Chemicals
S-1	No. CAS 1795	Rohm and Haas
S-2	No. ESA 1136	Rohm and Haas
S-3	No. ESA 1252-3	Rohm and Haas
S-4	No. ESA 1255-1	Rohm and Haas
S-5	No. FL 2915	Rohm and Haas
S-6	Haloflex 202 Primer	ICI Americas
S-8	No. 14JG-74A	Union Carbide
M-1	No. 931-R-4901	Fuller O'Brien
M-3	White Latex Primer	DeVoe Marine
M-11	No. 99X-0106 Gray	Stanchem

3. Conduct reformulation studies on the following formulations in order to improve the deficiencies observed (see Conclusion No. 1 above) without adversely affecting corrosion resistance:

F-4,	No. 7585D	Halox Pigments
F-15,	No. 30708-3	Celanese Chemicals

4. Request the suppliers to modify the following formulations in order to overcome the deficiencies observed (see Conclusion No. 1 above) without adversely affecting corrosion resistance:

M-6,	No. SA7981-G73	Sherwin-Williams
M-7,	No. SA8367-G73	Sherwin-Williams
M-8,	No. C-1501	General Electric Co.

5. Modify the following formulations to both improve their marginal corrosion resistance and other defects as well. See Conclusions Nos. 2 and 4 above.

F-2,	No. P-1686-116-3	Cargill
F-3,	No. 5727C	Halox Pigments
F-14,	No. 30708-2	Celanese Chemicals
F-16,	No. 39708-4	Celanese Chemicals
S-4,	No. ESA 1255-1	Rohm and Haas
S-7,	No. 191	Polyvinyl Chemical

6. Request the supplier to modify the following formulation to improve its marginal corrosion resistance as well as other defects. See Conclusion No. 2 above.

M-1,	No. 931-R-4901	Fuller O'Brien

7. Reformulate the following low VOC primers recommended for use on aluminum only in order to improve their other defects. See Conclusion No. 3 above.

F-1,	No. FX-8	Buckman Laboratories
F-8,	No. PWB-76	Reichard Coulston
F-9,	No. KK-1006-7A	Reichard Coulston
F-12,	No. RM-3	Wet Ground Mica Assoc.
F-13,	No. RN-3	Wet Ground Mica Assoc.
S-1,	No. CAS 1795	Rohm and Haas
S-2,	No. ESA 1136	Rohm and Haas
S-3,	No. ESA 1252-3	Rohm and Haas
S-5,	No. FL 2915	Rohm and Haas

S-6,	Haloflex 202 Primer	ICI Americas
S-8,	No. 14JG-74A	Union Carbide

8. Request the suppliers of the following low VOC primers, recommended for use on aluminum only, to modify their products in order to improve their other defects. See Conclusion No. 3 above.

M-3,	White Latex Primer	DeVoe Marine
M-11,	No. 99X-0106 Gray	Stanchem

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Appendix A-1

DL LABORATORIES

(FORMERLY DAVID LITTER LABORATORIES)

116 East 16th Street, New York, N.Y. 10003
Telephone: 212-777-4410

Letter to Publications

Re: PUBLICITY RELEASE

As you probably know, government regulations are severly controlling the content of our paints and coatings, especially with respect to air polluting solvents and toxic pigments.

The Armed Forces are not exempt from these regulations and therefore are attempting to meet them without degrading the performance of the paints and coatings they use. One of the steps being undertaken by the U.S. Army Mobility Equipment Research & Development Command is to develop new metal primer specifications to replace the conventional coatings presently used. In order to do so within a reasonable time, it is necessary to alert raw material suppliers to the proposed plan so that their products can be submitted as soon as possible.

We would therefore, appreciate your inserting the enclosed Publicity Release in an early issue of your publication. Please send us two copies of the printed release.

Thank you for your cooperation.

Sincerely,

Sidney B. Levinson
President

SBL/df
cc: S. Spindel

enc.

Appendix A-2

D/L LABORATORIES

(ESTABLISHED 1952)

116 East 16th Street, New York, N.Y. 10003
Telephone: 212-777-4410 TWX: 710-581-6132

Publicity Release

Re: U.S. ARMY SEEKING WATER-BORNE PRIMERS

The U.S. Army Mobility Equipment Research & Development Command is responsible for the development of paints and coatings for all Army equipment. At present, conventional coatings are in use but the Command is under pressure to meet current and anticipated restrictions on the content of volatile organic materials, as well as toxic inhibiting pigments, in these primers.

Therefore, a contract has been awarded to the D/L Laboratories to investigate, formulate and evaluate water borne metal primers which contain no lead or Chromium VI.

The following parameters have been specified:

1. Contain no lead or Chromium VI.
2. Contain a maximum of 3.5 lbs/gal of volatile organic compounds (VOC) when applied.
3. Solvents present shall meet Rule 66 or Rule 102 of SCAPCD.
4. Shall be capable of conventional application.
5. Shall be air drying.

The polymers used in these primers may be either water emulsifiable or water soluble provided that they meet these requirements.

The cooperation of the industry is solicited. Representatives of companies wishing to have their anti-corrosive pigment(s) or water borne polymer(s) included in this program, should call or write: Sidney B. Levinson, President, D/L Laboratories, 116 East 16th Street, New York, N.Y. 10003; (212) 777-4410.

Sincerely,

Sidney B. Levinson
President

SBL/df
cc: S. Spindel

D/L LABORATORIES

(ESTABLISHED 1952)

116 East 16th Street, New York, N.Y. 10003
Telephone: 212-777-4410 TWX: 710-581-6132

Letter to Polymer Manufacturers

Re: LEAD AND CHROME FREE WATER BORNE PRIMERS

The U.S. Army Mobility Equipment Research & Development Command is responsible for the development of paints and coatings for all Army equipment. At present, conventional coatings are in use but the Command is under pressure to meet current and anticipated restrictions on the content of volatile organic materials, as well as toxic inhibiting pigments, in these primers. Therefore, a contract has been awarded to the D/L Laboratories to investigate, formulate and evaluate water borne metal primers which contain no lead or Chromium VI.

The following parameters have been specified:

1. Contain no lead or Chromium VI.
2. Contain a maximum of 3.5 lbs/gal of volatile organic compounds (VOC) when applied.
3. Solvents present shall meet Rule 66 or Rule 102 of SCAPCD.
4. Shall be capable of conventional application.
5. Shall be air drying.

If you have any water borne polymers you wish to have included in this program, will you please submit (a) gallon sample (s). Also please send us your data and recommended metal primer formulations, if available.

Thank you for your cooperation.

Sincerely,

SBL/df
cc: S. Spindel

Sidney B. Levinson
President

D/L LABORATORIES

(FORMERLY DAVID LITTER LABORATORIES)

116 East 16th Street, New York, N.Y. 10003
Telephone: 212-777-4410

Letter to Pigment Manufacturers

Re: LEAD AND CHROME FREE WATER BORNE PRIMERS

The U.S. Army Mobility Equipment Research & Development Command is responsible for the development of paints and coatings for all Army equipment. At present, conventional coatings are in use but the Command is under pressure to meet current and anticipated restrictions on the content of volatile organic materials, as well as toxic inhibiting pigments, in these primers. Therefore, a contract has been awarded to the D/L Laboratories to investigate, formulate and evaluate water borne metal primers which contain no lead or Chromium VI.

The following parameters have been specified:

1. Contain no lead or Chromium VI.
2. Contain a maximum of 3.5 lbs/gal of volatile organic compounds (VOC) when applied.
3. Solvents present shall meet Rule 66 or Rule 102 of SCAPCD.
4. Shall be capable of conventional application.
5. Shall be air drying.

If you have any anti-corrosive pigments you wish to have included in this program, will you please sumit (a) 10 lb. sample(s). Also please send us your data and recommended metal primer formulations, if available.

Thank you for your cooperation.

Sincerely,

SBL/df
cc: S. Spindel

Sidney B. Levinson
President

D/L LABORATORIES

(FORMERLY DAVID LITTER LABORATORIES)

116 East 16th Street, New York, N.Y. 10003
Telephone: 212-777-4410

Letter to Additive Manufacturers

Re: LEAD AND CHROME FREE WATER BORNE PRIMERS

The U.S. Army Mobility Equipment Research & Development Command is responsible for the development of paints and coatings for all Army equipment. At present, conventional coatings are in use but the Command is under pressure to meet current and anticipated restrictions on the content of volatile organic materials, as well as toxic inhibiting pigments, in these primers. Therefore, a contract has been awarded to the D/L Laboratories to investigate, formulate and evaluate water borne metal primers which contain no lead or Chromium VI.

The following parameters have been specified:

1. Contain no lead or Chromium VI
2. Contain a maximum of 3.5 lbs/gal of volatile organic compounds (VOC) when applied.
3. Solvents present shall meet Rule 66 or Rule 102 of SCAPCD.
4. Shall be capable of conventional application.
5. Shall be air drying.

If you have any corrosion inhibitors or adhesion promoters you wish to have included in this program, will you please submit (a) one pound sample (s). Also please send us your data and recommended metal primer formulations, if available.

Thank you for your cooperation.

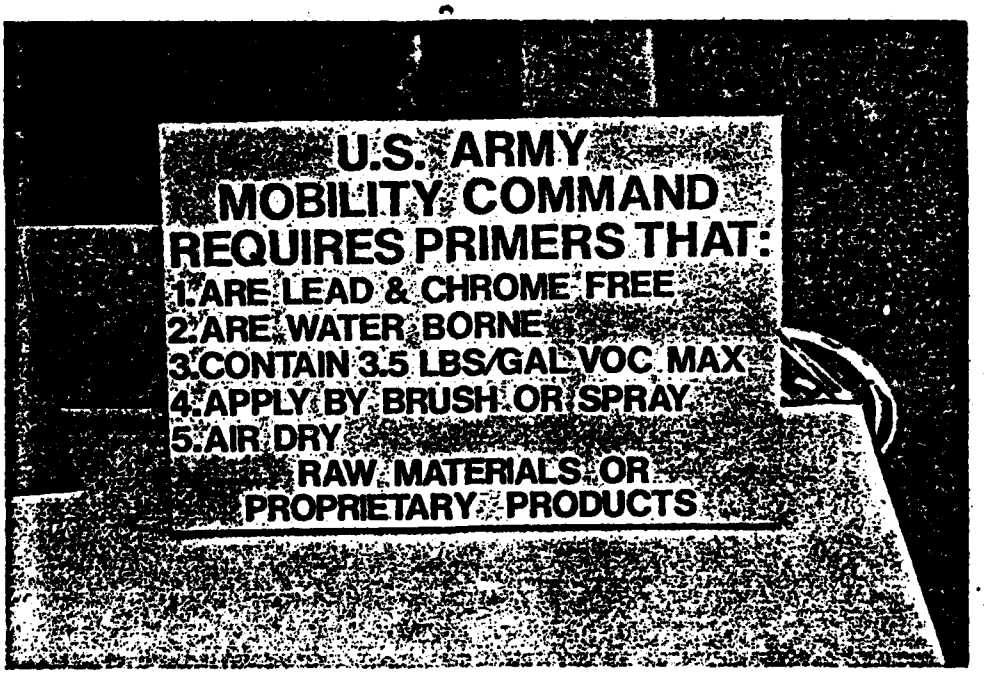
Sincerely,

SBL/df
cc: S. Spindel

Sidney B. Levinson
President

Appendix A-6

Display at Paint Show



D/L LABORATORIES

116 East 16th Street, New York, N.Y. 10003
Telephone: 212-777-4410

Appendix A-7

(ESTABLISHED 1952)

Letter to Metal Primer Manufacturers

Re: LEAD AND CHROME FREE WATER BORNE PRIMERS

The U.S. Army Mobility Equipment Research & Development Command is responsible for the development of paints and coatings for all Army Equipment. At present, conventional coatings are in use but the Command is under pressure to meet current and anticipated restrictions on the content of volatile organic materials, as well as toxic inhibiting pigments, in these primers. Therefore, a contract has been awarded to the D/L Laboratories to investigate, formulate and evaluate water borne metal primers which contain no lead or Chromiumm VI.

The following parameters have been specified:

1. Contain no lead or Chromium VI.
2. Contain a maximum of 3.5 lbs/gal of volatile organic compounds (VOC) when applied.
3. Shall be capable of conventional application.
4. Shall be air drying.

The formulations developed should conform to the corrosion inhibiting requirements of the following organic solvent primers or rust-inhibiting coatings:

TT-E-485	Enamel, Semigloss, Rust-Inhibiting.
TT-P-636	Primer Coating, Alkyd, Wood & Ferrous Metal.
TT-P-664	Primer Coating, Synthetic, Rust-Inhibiting, Lacquer Resisting.

LABORATORIES
116 East 16th Street, New York, N.Y. 10003

TT-P-1757 Primer Coating, Zinc Chromate, Low Moisture-Sensitivity.

MIL-P-23377 Primer Coating, Epoxy-Polyamide, Chemical and Solvent Resistant.

They should also meet the following specific requirements:

a. A projected package stability of at least one year.

b. Good freeze-thaw stability.

c. A flash point above 100°F.

d. Thinnable with water to both brushing and spray viscosities.

e. Air dry tack free within 6 hours.

f. Show no flash rusting when applied on steeel substrates.

g. Compatability with both conventional organic solvent and water borne topcoats.

h. Pass a 144 hour exposure to 5% salt fog.

i. Pass water and hydrocarbon immersion resistance tests without a top coat.

Although our contract calls for the formulation of the primers, we have been given approval to evaluate proprietary products provided that their formulations are divulged to US AMERADCOM under a confidentiality agreement.

If this is acceptable to you, please forward at least two quarts of each product with the following information:

1. VOC concentration in g/l or lbs/gal, less water.

2. Flash point

3. Instructions for use.

Thank you for your interest.

Sincerely,

Appendix B-1

Formulated Primers

TEST DATA		F-1	F-2	F-3	F-4	F-5	F-7	F-8
VOC (as applied)	gm/l	101	324	348	216	216	6	159
	lbs/gal	0.8	2.7	2.9	1.8	1.8	0.1	1.3
Weight per Gallon	lbs	10.47	10.86	10.26	9.70	10.67	10.44	11.19
Total Solids	%	51.6	52.4	47.9	43.3	43.3	60.9	58.3
Flash Point	°F	150+	150+	139	150+	150+	150+	150+
Viscosity	KU							
Initial		61	102	122	115	64	61	78
4 weeks at 125°F		Sol	Coag	119	141+	63	54	68
Freeze-thaw		Coag	110	116	141	74	Coag	75
Storage Stability	Score							
Liquid separation		9	2	8	8	8	2	4
Skinning		2	10	6	10	10	10	10
Pigment settling		9	10	6	9	9	2	6
Ease of remixing		0	0	8	9	9	2	4
Speed of Dry	Hrs							
Set to touch		0.3	0.4	0.3	0.2	0.4	0.4	0.2
Dry tack free		0.6	1.6	5.5	4.5	1.4	0.5	2.1
Dry hard		0.6	1.6	6.0	4.5	1.4	0.8	2.1
Dry thru		0.7	1.8	4.0	3.5	1.8	24+	3.1
Sprayability	Score	10	10	10	10	*	10	10
Brushability	Score	10	4	2	6	10	10	8
Adhesion To -								
Bonderized steel	Score	10	10	10	8	*	10	10
Aluminum	"	10	10	10	10	*	10	10

Sol - Solidified Coag - Coagulated * Flash rust - sample rejected

Appendix B-1 (Cont)

Formulated Primers

TEST DATA		F-9	F-10	F-11	F-12	F-13	F-14	F-15	F-16
VOC (as applied)	gm/l	324	258	252	85	80	300	300	300
	lbs/gal	2.7	2.2	2.1	0.7	0.7	2.5	2.5	2.5
Weight per Gallon	lbs	10.03	10.35	10.52	12.11	11.58	10.63	10.60	10.63
Total Solids	%	51.7	48.1	50.0	57.3	53.6	69.7	69.5	59.7
Flash Point	°F	131	115	150+	150+	150+	107	100	117
Viscosity	KU								
Initial		80	132	65	70	72	95	95	141+
4 weeks at 125°F		Sol	Coag	Coag	141+	123	Coag	106	Coag
Freeze-thaw		82	141+	60	72	80	88	88	141+
Storage Stability	Score								
Liquid separation		2	2	2	8	8	6	8	8
Skinning		0	9	9	2	6	10	8	10
Pigment settling		0	6	10	9	9	10	10	10
Ease of remixing		0	0	0	9	9	0	9	0
Speed of Dry	Hrs						*		*
Set to touch		0.2	0.4	0.4	0.4	0.4		0.5	
Dry tack free		0.6	1.0	O/N	0.5	0.4		5.0	
Dry hard		1.2	2.0	O/N	0.6	0.5		O/N	
Dry thru		1.7	2.5	O/N	0.8	0.7		O/N	
Sprayability	Score	10	10	10	10	10	10	10	10
Brushability	Score	6	8	8	10	10	8	10	8
Adhesion To -									
Bonderized steel	Score	10	10	10	10	10	10	10	10
Aluminum	"	10	10	10	10	10	10	10	10

Sol - Solidified
Coag - Coagulated
O/N - Overnight (8-16 hrs)
* - Not tested due to very poor storage stability

Appendix B-1 (Cont)

Formulated Primers

TEST DATA		F-1	F-2	F-3	F-4	F-5	F-7	F-8	TT-P-1757
SALT FOG EXPOSURE									
Bonderized Steel									
DFT - 1.0 mil	Hrs	72	144	144	144	No	72	144	144
Blistering	ASTM								
At X		6F	10	8M	8F	test	8F	6M	10
Overall		4F	8F	8M	8F		8F	6M	10
Corrosion	Score								
At X		8	8	8	8		4	6	9
Overall		6	6	10	8		4	6	10
DFT - 1.5 mils	Hrs	72	144	144	144		72	144	144
Blistering	ASTM								
At X		10	10	8M	8F		8F	6F	10
Overall		4F	6F	8M	8F		8F	6F	10
Corrosion	Score								
At X		8	9	8	8		6	8	9
Overall		8	8	10	9		6	8	10
Aluminum									
DFT - 1.0 mil	Hrs	144	144	144	144		144	144	144
Blistering	ASTM								
At X		10	10	8M	10		10	10	10
Overall		10	10	8M	10		10	10	10
Corrosion	Score								
At X		10	10	10	10		10	10	10
Overall		10	10	10	10		10	10	10
DFT - 1.5 mils		144	144	144	144		144	144	144
Blistering	ASTM								
At X		10	10	10	10		10	10	10
Overall		10	10	8F	10		10	10	10
Corrosion	Score								
At X		10	10	10	10		10	10	10
Overall		10	10	10	10		10	10	10

Appendix B-1 (Cont)

Formulated Primers

TEST DATA		F-9	F-10	F-11	F-12	F-13	F-14	F-15	F-16
SALT FOG EXPOSURE									
Bonderized Steel									
DFT - 1.0 mil	Hrs	97	144	144	72	72	144	144	144
Blistering	ASTM								
At X		8MD	10	8M	8M	8M	10	10	8F
Overall		8M	6M	6F	8M	8M	6F	10	8F
Corrosion	Score								
At X		4	8	6	4	6	8	9	6
Overall		6	9	9	4	6	9	10	8
DFT - 1.5 mils	Hrs	144	144	144	72	144	144	144	144
Blistering	ASTM								
At X		8MD	10	10	8M	4M	10	10	10
Overall		8M	9MD	10	8M	4M	10	10	10
Corrosion	Score								
At X		6	6	9	6	6	8	9	8
Overall		6	10	10	8	8	9	10	9
Aluminum									
DFT - 1.0 mil	Hrs	144	144	144	144	144	144	144	144
Blistering	ASTM								
At X		10	10	10	10	10	10	10	10
Overall		10	9MD	10	10	10	10	10	10
Corrosion	Score								
At X		10	10	10	10	10	10	10	10
Overall		10	10	10	10	10	10	10	10
DFT - 1.5 mils	Hrs	144	144	144	144	144	144	144	144
Blistering	ASTM								
At X		10	10	10	10	10	10	10	10
Overall		10	9MD	10	10	10	10	10	10
Corrosion	Score								
At X		10	10	10	10	10	10	10	10
Overall		10	10	10	10	10	10	10	10

Appendix B-2

Submitted by Raw Materials Suppliers

TEST DATA		S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8
VOC (as applied)	gm/l	284	131	308	294	326	127	264	56
	lbs/gal	2.4	1.1	2.6	2.5	2.7	1.1	2.2	0.5
Weight per Gallon	lbs	10.96	10.28	11.26	10.19	10.17	11.94	10.83	10.48
Total Solids	%	50.6	50.3	50.3	52.3	52.0	60.6	52.1	41.8
Flash Point	°F	150+	150+	150+	150+	150+	150+	150+	120
Viscosity	KU								
Initial		75	136	118	141+	121	72	54	67
4 weeks at 125°F		141+	141+	141+	141+	141+	85	55	71
Freeze-thaw		Coag	139	124	141+	134	Coag	Coag	68
Storage Stability	Score								
Liquid separation		8	8	8	6	8	6	8	6
Skinning		2	2	9	2	6	9	9	9
Pigment settling		10	9	9	9	9	8	2	9
Ease of remixing		8	8	9	6	9	8	2	9
Speed of Dry	Hrs								
Set to touch		0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.3
Dry tack free		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.4
Dry hard		0.2	0.8	1.9	3.1	3.1	0.2	0.2	0.4
Dry thru		0.3	1.7	4.0	3.6	3.6	0.3	0.3	0.5
Sprayability	Score	10	10	10	10	10	10	10	10
Brushability	Score	10	9	8	6	6	10	10	9
Adhesion To -									
Bonderized Steel	Score	10	10	10	10	10	10	10	10
Aluminum	"	10	10	10	10	10	10	10	10

Appendix B-2 (Cont)

Submitted by Raw Material Suppliers

TEST DATA		S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8
SALT FOG EXPOSURE									
Bonderized Steel									
DFT - 1.0 mil	Hrs	144	144	144	144	144	97	144	24
Blistering	ASTM								
At X		4F	8MD	6M	8M	8F	8MD	8M	6F
Overall		4M	8MD	6M	8F	6M	8MD	8M	6M
Corrosion	Score								
At X		8	6	6	6	6	8	6	6
Overall		8	6	8	8	6	6	6	6
DFT - 1.5 mils	Hrs	144	144	144	144	144	144	144	144
Blistering	ASTM								
At X		10	8F	6F	8F	8F	8D	9M	4M
Overall		4M	8F	10	8F	4F	8D	9M	2M
Corrosion	Score								
At X		8	8	9	8	6	8	10	6
Overall		8	10	10	9	8	8	10	8
Aluminum									
DFT - 1.0 mil	Hrs	144	144	144	144	144	144	144	144
Blistering	ASTM								
At X		10	10	10	10	10	10	8F	10
Overall		10	10	10	10	10	10	8F	10
Corrosion	Score								
At X		10	10	10	10	10	10	6	10
Overall		10	10	10	10	10	10	6	10
DFT - 1.5 mils	Hrs	144	144	144	144	144	144	144	144
Blistering	ASTM								
At X		10	10	10	10	10	10	10	10
Overall		10	10	10	10	10	8F	10	10
Corrosion	Score								
At X		10	10	10	10	10	9	10	10
Overall		10	10	10	10	10	9	10	10

Appendix B-3

Proprietary Primers

TEST DATA		M-1	M-2	M-3	M-4	M-5*
VOC (as applied)	gm/l	128	41	217	72	364
	lbs/gal	1.1	0.3	1.8	0.6	3.0
Weight per Gallon	lbs	10.81	12.04	10.75	11.48	10.23
Total Solids	%	54.9	62.4	51.1	72.6	52.7
Flash Point	°F	150+	150+	150+	140	90/150
Viscosity	KU					
Initial		55	83	92	91	91/141+
4 weeks at 125°F		86	74	74	141+	141/141+
Freeze-thaw		Coag	Coag	141+	92	92/***
Storage Stability	Score					
Liquid separation		2	4	8	8	8/8
Skinning		10	10	9	9	9/6
Pigment settling		2	6	2	9	6/9
Ease of remixing		2	9	2	9	8/9
Speed of Dry	Hrs					
Set to touch		0.2	0.2	0.2	**	0.2
Dry tack free		0.5	0.3	0.6		24+
Dry hard		0.6	0.3	0.8		24+
Dry thru		0.9	0.3	0.8		24+
Sprayability	Score	10	10	10	10	10
Brushability	Score	10	10	8	6	10
Adhesion To -						
Bonderized steel	Score	10	10	10	10	10
Aluminum	"	10	10	10	10	10

Coag - Coagulated

* Two component (Pot life = 24 + hrs)

** Very gritty - dropped

*** Insufficient to test

Appendix B-3 (Cont)

Proprietary Primers

TEST DATA		M-6	M-7	M-8	M-9	M-10	M-11
VOC (as applied)	gm/l	277	254	333	360	28	146
	lbs/gal	2.3	2.1	2.8	3.0	0.2	1.2
Weight per Gallon	lbs	10.70	10.63	10.01	11.02	10.34	9.97
Total Solids	%	50.2	47.1	45.7	60.5	55.1	38.5
Flash Point	°F	120	150	130	94	150+	150+
Viscosity	KU						
Initial		98	82	58	103	64	89
4 weeks at 125°F		Coag	Coag	95	117	72	92
Freeze-thaw		102	74	83	X	64	Coag
Storage Stability	Score						
Liquid separation		4	2	6	9	8	8
Skinning		10	10	10	4	9	9
Pigment settling		10	10	10	9	9	9
Ease of remixing		0	0	8	9	9	9
Speed of Dry	Hrs						
Set to touch		0.2	0.2	0.3	0.5	0.2	0.3
Dry tack free		0.3	0.3	0.8	O/N	0.2	0.4
Dry hard		0.8	2.0	1.0	O/N	0.3	0.4
Dry thru		1.7	2.0	1.0	O/N	0.5	0.5
Sprayability	Score	10	10	10	10	10	10
Brushability	Score	10	10	10	8	2	10
Adhesion To -							
Bonderized steel	Score	10	10	10	10	10	10
Aluminum	"	10	10	10	10	10	10

Coag - Coagulated O/N - Overnight (8-16 hrs) X - Not applicable - solvent thinned

Appendix B-3 (Cont)
Proprietary Primers

TEST DATA

SALT FOG EXPOSURE		M-1	M-2	M-3	M-4	M-5	TT-P-1757
Bonderized Steel							
DFT - 1.0 mil	Hrs	144	65	24	No	120	144
Blistering	ASTM						
At X		8F	8D	8F	test	2MD	10
Overall		6F	8D	8M		4MD	10
Corrosion	Score						
At X		6	8	8		6	9
Overall		6	9	4		8	10
DFT - 1.5 mils	Hrs	144	144	24		120	144
Blistering	ASTM						
At X		8F	6F	10		2MD	10
Overall		8M	9D	8F		4MD	10
Corrosion	Score						
At X		8	8	8		6	9
Overall		8	10	6		8	10
Aluminum							
DFT - 1.0 mil	Hrs	144	*	144		144	140
Blistering	ASTM						
At X		10		10		10	10
Overall		10		10		10	10
Corrosion	Score						
At X		10		10		10	10
Overall		10		10		10	10
DFT - 1.5 mils	Hrs	144	*	144		144	144
Blistering	ASTM						
At X		10		10		10	10
Overall		10		10		10	10
Corrosion	Score						
At X		10		10		10	10
Overall		10		10		10	10

* Panels pitted due to pH of 4.8

Appendix B-3 (Cont)
Proprietary Primers

TEST DATA		M-6	M-7	M-8	M-9	M-10	M-11
SALT FOG EXPOSURE							
Bonderized Steel							
DFT - 1.0 mil	Hrs	144	144	144	144	28	72
Blistering	ASTM						
At X		8F	8F	8F	4M	10	6D
Overall		8F	8F	8F	6F	9M	6D
Corrosion	Score						
At X		8	8	8	8	6	4
Overall		10	10	8	9	8	4
DFT - 1.5 mils	Hrs	144	144	144	144	28	98
Blistering	ASTM						
At X		10	10	10	10	10	6MD
Overall		9F	9F	8F	10	8M	6MD
Corrosion	Score						
At X		9	9	8	9	6	2
Overall		10	10	9	10	8	2
Aluminum							
DFT - 1.0 mil	Hrs	144	144	144	144	144	144
Blistering	ASTM						
At X		10	10	10	10	8F	10
Overall		10	10	10	10	6M	8F
Corrosion	Score						
At X		10	10	10	10	10	10
Overall		10	10	10	10	10	10
DFT - 1.5 mils	Hrs	144	144	144	144	144	144
Blistering	ASTM						
At X		10	10	10	10	8F	10
Overall		10	10	10	10	6F	10
Corrosion	Score						
At X		10	10	10	10	10	10
Overall		10	10	10	10	10	10

Appendix C-1

FORMULATIONS

No. F-1	Formulation FX-8 Lbs	Gals	Buckman Laboratories Supplier
Arolon 585	128.9	14.48	45
Butyl Cellosolve	19.9	2.65	52
Triton X-405	5.7	0.62	42
Water	49.3	5.91	-
Busperse 53	1.0	0.11	3
Ti-Pure R-900	165.9	4.85	15
Busan 11-M1	47.4	1.73	3
Attagel 50	9.5	0.48	17
	Disperse on Cowles to 4-5 Heg. Let Down With		
Arolon 585	543.1	61.02	45
Water	21.8	2.62	-
Cobalt - 6%	1.9	0.26	48
Zirconium - 6%	5.6	0.80	48
Total	1000.0	95.53	

Weight per Gallon = 10.47 lbs

VOC = 101 gms/liter

0.8 lbs/gal

Appendix C-1

FORMULATIONS

No. F-2	Formulation P-1686-116-3		Cargill, Inc.
	Lbs	Gals	Supplier
Alkyd 7418	176.1	20.47	5
Ethylene Glycol Monobutyl Ether	70.4	9.37	52
Ammonium Hydroxide - 28%	12.5	1.66	-
Water	229.3	27.53	-
Atomite	87.6	3.88	49
Mistron Talc	58.5	2.54	9
1475 Red Oxide	92.9	2.32	40
Zinc Phosphate #317	77.8	2.87	40
Imsil A-10	19.5	0.88	26
Aerosil R-972	7.5	0.41	11
Ben-a-gel EW	2.2	0.11	34
Byk 301	0.9	0.11	4
	Disperse on Pebble Mill Let Down With		
Alkyd 7418	44.2	5.14	5
Ammonium Hydroxide - 28%	1.9	0.25	-
Ethyl Glycol Monobutyl Ether	17.8	2.37	52
6% Cobalt Intercar	1.8	0.25	28
6% Zirconium Intercar	0.9	0.13	28
Activ - 8	0.9	0.11	53
Water	97.3	11.68	-
Total	1000.0	92.08	

Weight per Gallon = 10.86 lbs

VOC = 324 gms/liter

2.7 lbs/gal

Appendix C-1

FORMULATIONS

No. F-3	Formulation 5727C		Halox Pigments
	Lbs	Gals	Supplier
Water)	90.7	10.89	-
Kelsol 3921) Premix	105.8	12.24	45
Triethylamine)	5.6	0.60	52
EA-1075	21.6	3.13	34
Cobalt Hydrocure - 6%	1.9	0.25	33
Manganese Hydrocure - 6%	1.9	0.25	33
Halox BW-191	92.6	3.90	24
R-900	164.5	4.94	15
Lampblack #101	6.9	0.47	37
	Disperse and Let Down With		
Water	112.2	13.48	-
Butyl Cellosolve	25.9	3.47	52
Kelsol 3921)	181.3	20.99	45
Water) Premix	95.0	11.41	-
Triethylamine)	8.6	0.92	52
Water	60.4	7.25	-
Butyl Cellosolve	17.3	2.31	52
	Adjust pH to 8.3 - 8.5 With		
Water & Ammonium Hydroxide	7.8	0.98	-
Total	1000.0	97.48	

Weight per Gallon = 10.26 lbs

VOC = 348 gms/liter

2.9 lbs/gal

Appendix C-1

FORMULATIONS

No. F-4	Formulation 7585D		Halox Pigments
	Lbs	Gals	Supplier
Water	83.7	10.04	-
Natrosol 250 MHR	0.8	0.07	25
Ammonium Hydroxide - 28%	1.1	0.14	-
Methyl Carbitol	54.3	7.23	52
QR-681M	21.0	2.33	42
CO-630	2.9	0.34	20
Surfynol 104E	4.5	1.05	1
R-900	54.3	1.63	15
Atomite	54.3	2.41	49
Halox BW-191	62.5	2.63	24
Kadox 515	5.4	0.12	23
	Disperse and Let Down With		
Rhoplex MV-23	540.5	61.42	42
Texanol	5.8	0.73	16
Aroplaz 1271	55.7	6.66	45
Zirconium - 6%	3.4	0.47	48
Cobalt - 6%	0.3	0.04	48
Manganese - 6%	0.3	0.04	48
Foamaster VL	1.1	0.14	12
Skane M-8	2.2	0.25	42
Water	29.6	3.55	-
QR-708	16.3	1.82	42
Total	1000.0	103.11	

Weight per Gallon = 9.70 lbs

VOC = 216 gms/liter

1.8 lbs/gal

Appendix C-1

FORMULATIONS

No. F-5 — **Mineral Pigments**

	Lbs	Gals	Supplier
Water	233.4	28.01	-
QP-1500	3.3	0.28	52
KTPP	0.9	0.09	46
Tamol 850	5.6	0.65	42
Ethylene Glycol	28.0	2.99	52
Dalpad A	11.2	1.21	22
Dibutyl Phthalate	7.5	0.84	52
Igepal 630	2.8	0.28	20
Nopco NXZ	1.9	0.28	12
Dowcil 75	1.4	0.09	13
R-900	140.1	4.20	15
Phos-Plus	93.4	3.55	10
Atomite	46.7	1.87	49
	Disperse and Let Down With		
UCAR 4358	329.5	38.10	52
Nopco NXZ	0.9	0.09	12
Water	93.4	11.20	-
Total	1000.0	93.73	

Weight per Gallon = 10.67

VOC = 216 gms/liter

1.8 lbs/gal

Appendix C-1

FORMULATIONS

No. F-7	Formulation 137-68		PVO International
	Lbs	Gals	Supplier
Water	218.4	26.21	-
Igepal CO-630	4.7	0.38	20
KTPP	2.8	0.19	46
Natrosol 250 HR	2.8	0.19	25
J1310 Zinc Chromate	142.5	4.37	32
1400 Red Iron Oxide	23.8	0.57	37
Gold Bond R	189.9	8.64	47
Drew L-475	1.9	0.28	14
	Disperse on Pebble Mill Let Down With		
CEE-5 Emulsion	413.2	54.89	39
Total	1000.0	95.72	

Weight per Gallon = 10.44 lbs

VOC = 6.2 gms/liter

0.1 lb/gal

Appendix C-1

FORMULATIONS

No. F-8	Formulation PWB-76		Reichard-Coulston
	Lbs	Gals	Supplier
Water	112.0	13.44	-
Tamol 731	15.2	1.66	42
Triton CF-10	2.7	0.30	42
Foamaster G	1.8	0.23	12
Ethylene Glycol	25.1	2.68	52
Dowcil 75	0.5	0.04	13
551 Lecithin	1.8	0.20	43
Cellosize QP-4400	1.3	0.12	52
3097 Red Oxide	89.6	2.19	37
317 Zinc Phosphate	31.3	1.16	40
325 Mesh W.G. Mica	29.6	1.26	18
Atomite	179.1	7.93	49
J1310 Zinc Yellow	4.5	0.15	32
	Disperse and Let Down With		
Arolon X820	433.4	49.26	45
Foamaster G	0.9	0.12	12
Butyl Carbitol	5.4	0.68	52
Butyl Carbitol Acetate	5.4	0.66	52
Aroplaz 1271	22.4	2.68	45
Triton CF-10	1.3	0.14	42
Water	31.3	3.76	-
Ammonium Hydroxide - 28%	5.4	0.72	-
Total	1000.0	89.38	

Weight per Gallon = 11.19 lbs

VOC = 159 gms/liter

1.3 lbs/gal

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FORMULATIONS

No. F-9	Formulation KK-1006-7A		Reichard-Coulston
	Lbs	Gals	Supplier
Titanox 2020	84.1	2.47	34
Mapico Black	2.5	0.06	8
ASP-100	59.3	2.77	17
Atomite	59.3	2.64	49
Moly White 212	49.4	1.98	44
38-690 Epotuf	168.1	19.98	41
	Disperse and Let Down With		
38-690 Epotuf	192.8	22.94	41
Triethylamine	16.8	2.76	52
6% Cobalt Napthenate	1.7	0.21	48
4% Calcium Napthenate	9.9	1.32	48
Troykyd LLBA	19.8	2.23	50
	Mix Well and Add		
Water	336.3	40.37	-
Total	1000.0	99.73	

Weight per Gallon = 10.03 lbs

VOC = 324 gms/liter

2.7 lbs/gal

Appendix C-1

FORMULATIONS

No. F-10	Formulation 1855-32A		Spencer Kellogg
	Lbs	Gals	Supplier
Water	202.9	24.35	-
Ammonium Hydroxide - 28%	8.2	1.08	-
Kelsol 3906	101.3	11.78	45
Butyl Cellosolve	10.1	1.35	52
Cobalt Nuocure - 6%	4.1	0.52	33
Manganese Nuocure - 6%	4.1	0.54	33
Activ - 8	1.5	0.19	53
Sparmite Barytes	76.0	2.05	37
Halox SW-111	71.1	2.99	24
Mapico 297	50.8	1.18	8
Atomite	45.7	2.03	49
399 Talc	25.4	1.13	54
	Disperse on Pebble Mill Let Down With		
Water	202.9	24.36	-
Ammonium Hydroxide - 28%	8.2	1.08	-
Kelsol 3906	177.6	20.65	45
Butyl Cellosolve	10.1	1.35	52
Total	1000.0	96.63	

Weight per Gallon = 10.35 lbs

VOC = 258 gms/liter

2.2 lbs/gal

Appendix C-1

FORMULATIONS

No. F-11	Formulation 2007-10-1		Spencer Kellogg
	Lbs	Gals	Supplier
Water	135.4	16.19	-
Triethylamine	5.4	0.89	52
Kelsol 3920	71.9	8.36	45
R-902	71.9	2.10	15
Raven Black 1020	0.9	0.06	8
Barytes W-1430F	89.9	2.44	37
Talc 399	80.9	3.60	54
Zinc Phosphate 317	44.9	1.72	40
Butyl Cellosolve	15.3	2.03	52
Butyl Carbitol	9.9	1.25	52
Patcote 531	0.4	0.06	36
Disperse on Pebble Mill to 6 Heg. Let Down With			
Kelsol 3920	170.7	19.86	45
Aroplaz 1272	19.8	2.36	45
Ammonium Hydroxide - 28%	9.0	1.20	-
Cobalt Hydrocure - 6%	1.8	0.23	33
Manganese Hydrocure - 6%	1.8	0.23	33
Exkin #2	0.4	0.06	48
Water	269.7	32.37	-
Total	1000.0	95.01	

Weight per Gallon = 10.52 lbs

VOC = 252 gms/liter

2.1 lbs/gal

Appendix C-1

FORMULATIONS

No. F-12	Formulation RM-3		Wet Ground Mica Ass.
	Lbs	Gals	Supplier
Cellosize QP-4400 - 2.5%	71.6	8.52	52
Ethylene Glycol	17.8	1.90	52
Tamol 731	8.0	0.87	42
Triton CF-10	1.8	0.20	42
Nopco NXZ	1.8	0.27	12
TiPure R-900	170.8	5.13	15
Atomite	81.9	3.63	49
Moly White 212	46.0	1.84	44
325 Mesh W.G. Mica	40.4	1.72	18
Kadox 15	4.9	0.10	23
	Disperse and Let Down With		
Water	62.5	7.51	-
Rhoplex MV-23	485.1	50.02	42
Tri-butyl phosphate	4.0	0.49	52
Nopco NXZ	1.8	0.27	12
Merbac 35	1.6	0.14	31
Total	1000.0	82.61	

Weight per Gallon = 12.11 lbs

VOC = 85 gms/liter

0.7 lb/gal

Appendix C-1

FORMULATIONS

No. F-13

	Formulation RN-3		Wet Ground Mica Ass.
	Lbs	Gals	Supplier
Bentone LT - 2.5%	146.1	17.14	34
Ethylene Glycol	20.1	2.15	52
Tamol 850	4.6	0.47	42
Triton X-100	2.3	0.26	42
Nopco NXZ	0.9	0.14	12
TiPure R-900	91.3	2.74	15
Gold Bond R	91.3	4.14	47
325 Mesh W.G. Mica	45.6	1.94	18
Nalzin SC-1	41.1	1.21	34
Atomite	27.4	1.21	49
Disperse and Let Down With			
Water	16.4	1.97	-
Rhoplex MV-23	502.1	51.76	42
Tamol 850	4.5	0.47	42
Tributyl Phosphate	4.5	0.56	52
Nopco NXZ	0.9	0.13	12
Merbac 35	0.9	0.07	31
Total	1000.0	86.36	

Weight per Gallon = 11.58 lbs

VOC = 80 gms/liter

0.7 lb/gal

Appendix C-1

FORMULATIONS

No. F-14	Formulation 30708-2		Celanese Chemical
	Lbs	Gals	Supplier
Celanese 30708-2	99.7	11.85	6
Triton X-405	7.7	0.83	42
Water	85.2	10.22	-
Ammonium Hydroxide - 28%	6.6	0.89	-
Busperse 53	1.3	0.16	3
R-900	223.6	6.54	15
Busan 11 M-1	63.9	2.33	3
Attagel 50	12.8	0.65	17
	Disperse to 4-5 Heg. Let Down With		
Celanese 30708	419.8	49.92	6
Butyl Cellosolve	26.8	3.37	52
NuXtra Manganese - 6%	12.8	1.71	48
NuXtra Cobalt - 6%	12.8	1.74	48
NuXtra Zirconium - 6%	12.8	1.78	48
Ammonium Hydroxide - 28%	14.2	1.89	-
Total	1000.0	94.08	

Weight per Gallon = 10.63 lbs

VOC = 300 gms/liter

2.5 lbs/gal

Appendix C-1

FORMULATIONS

No. F-15	Formulation 30708-3		Celanese Chemical
	Lbs	Gals	Supplier
Celanese 30708-3	99.0	11.77	6
Triton X-405	7.6	0.83	42
Water	84.6	10.16	-
Ammonium Hydroxide - 28%	8.5	1.13	-
Busperse 53	1.3	0.16	3
R-900	222.2	6.50	15
Busan 11 M-1	63.5	2.31	3
Attagel 50	12.7	0.64	17
	Disperse to 4-5 Heg. Let Down With		
Celanese 30708	417.1	49.60	6
Butyl Cellosolve	26.7	3.55	52
NuXtra Manganese - 6%	12.7	1.70	48
NuXtra Cobalt - 6%	12.7	1.73	48
NuXtra Zirconium - 6%	12.7	1.77	48
Ammonium Hydroxide - 28%	18.7	2.51	-
Total	1000.0	94.36	

Weight per Gallon = 10.60 lbs

VOC = 300 gms/liter

2.5 lbs/gal

Appendix C-1

FORMULATIONS

No. F-16	Formulation 30708-4		Celanese Chemical
	Lbs	Gals	Supplier
Celanese 30708-4	99.8	11.86	6
Triton X-405	7.7	0.84	42
Water	85.3	10.23	-
Ammonium Hydroxide - 28%	16.1	2.15	-
Busperse 53	1.3	0.16	3
R-900	223.8	6.55	15
Busan 11 M-1	64.0	2.33	3
Attagel 50	12.8	0.65	17
	Disperse to 4-5 Heg. Let Down With		
Celanese 30708	420.1	49.97	6
Butyl Cellosolve	26.9	3.57	52
NuXtra Manganese - 6%	12.8	1.71	48
NuXtra Cobalt - 6%	12.8	1.74	48
NuXtra Zirconium - 6%	12.8	1.78	48
Ammonium Hydroxide - 28%	3.8	0.51	-
Total	1000.0	94.05	

Weight per Gallon = 10.63 lbs

VOC = 300 gms/liter

2.5 lbs/gal

Appendix C-2

FORMULATIONS

No. S-1	Formulation CAS 1795		Rohm & Haas Co.
	Lbs	Gals	Supplier
Butyl Cellosolve	41.8	5.49	52
Water	124.6	14.93	-
Dee Fo 806-102	1.0	0.13	51
Igepal CTA-639	3.1	0.38	20
Tamol 165	13.5	1.69	42
Red Iron Oxide RO-8097	75.0	1.77	37
Busan 11 M-1	62.2	2.26	3
499 Talc	77.1	3.43	29
290 Barytes Lo-Micron	108.2	2.88	54
	Disperse to 7 Heg. Let Down With		
Rhoplex WL-91	381.9	44.43	42
Triton X-405	9.0	1.01	42
Butyl Carbitol	23.8	2.99	52
Dibutyl Phthalate	15.8	1.80	52
Butyl Cellosolve	37.8	5.03	52
Ammonium Hydroxide - 14%	6.2	0.75	-
Ammonium Benzoate - 10%	19.0	2.29	-
Total	1000.0	91.20	

Weight per Gallon = 10.96 lbs

VOC = 284 gms/liter

2.4 lbs/gal

Appendix C-2

FORMULATIONS

No. S-2	Formulation ESA-1136		Rohm & Haas Co.
	Lbs	Gals	Supplier
Water	54.5	6.54	-
Methyl Carbitol	54.5	6.32	52
QR-681M	19.5	2.13	42
Amp-95	2.9	0.35	2
Triton CF-10	2.9	0.33	42
Drew L-405	2.7	0.39	14
Kadox 515	6.8	0.15	23
Red Oxide RO-8097	53.5	1.31	37
Atomite	81.1	3.58	49
Nalzin SC-1	77.8	2.31	34
	Disperse and Let Down With		
Rhoplex MV-23	576.0	65.65	42
Texanol	6.2	0.79	16
Aroplaz 1271 & Driers*	29.2	3.49	-
Sodium Nitrite - 13.8%	7.8	0.93	-
Skane M-8	2.0	0.22	42
Drew L-493	3.3	0.48	14
QR-708	6.8	0.76	42
Water	12.5	1.51	-
Total	1000.0	97.25	

* Aroplaz 1271	93.4%)	45
6% Cobalt Napthenate	0.5%) Premix	48
6% Manganese Napthenate	0.5%)	48
6% Zirconium Napthenate	5.6%)	48

Weight per Gallon = 10.28 lbs

VOC = 131 gms/liter

1.1 lbs/gal

Appendix C-2

FORMULATIONS

No. S-3	Formulation ESA-1252-3		Rohm & Haas Co.
	Lbs	Gals	Supplier
Water	37.9	4.54	-
Methyl Carbitol	55.2	6.40	52
QR-681M	24.5	2.68	42
Amp-95	3.0	0.35	2
Triton CF-10	3.0	0.34	42
Dreq L-405	2.8	0.39	14
Kadox 515	6.7	0.15	23
Red Oxide RO-8097	54.2	1.33	37
Atomite	74.3	3.29	49
Halox BW-191	78.8	3.32	24
	Disperse and Let Down With		
Water	17.0	2.05	-
Rhoplex MV-23	551.0	52.98	42
Texanol	5.9	0.75	16
Aroplaz 1271 + Driers*	60.1	7.19	-
Sodium Nitrite - 13.8%	7.9	0.95	-
Drew L-493	3.3	0.48	14
QR-708	14.4	1.61	42
Total	1000.0	88.8	
* Aroplaz 1271	93.4%)		45
6% Cobalt Napthenate	0.5%)	Premix	48
6% Manganese Napthenate	0.5%)		48
6% Zirconium Napthenate	5.6%)		48

Weight per Gallon = 11.26 lbs

VOC = 308 gms/liter

2.6 lbs/gal

Appendix C-2

FORMULATIONS

No. S-4	Formulation ESA-1255-1		Rohm & Haas Co.
	Lbs	Gals	Supplier
Water	37.5	4.51	-
Methyl Carbitol	54.8	6.35	52
QR-681M	24.3	2.67	42
Amp-95	2.9	0.35	2
Triton CF-10	2.9	0.33	42
Drew L-405	2.7	0.39	14
Kadox 515	6.7	0.15	23
Red Oxide RO-8097	53.8	1.32	37
Atomite	81.0	3.59	49
Zinc Phosphate #317	78.2	2.88	40
	Disperse and Let Down With		
Water	16.9	2.42	-
Rhoplex MV-23	547.0	62.32	42
Texanol	5.9	0.74	16
Aroplaz 1271 + Driers*	60.0	7.14	-
Sodium Nitrite - 13.8%	7.8	0.94	-
Drew L-493	3.3	0.48	14
QR-708	14.3	1.58	42
Total	1000.0	98.16	

* Aroplaz 1271	93.4%)	45
6% Cobalt Napthenate	0.5%) Premix	48
6% Manganese Napthenate	0.5%)	48
6% Zirconium Napthenate	5.6%)	48

Weight per Gallon = 10.19 lbs

VOC = 294 gms/liter

2.5 lbs/gal

Appendix C-2

FORMULATIONS

No. S-5	Formulation FL-2915		Rohm & Haas Co.
	Lbs	Gals	Supplier
Water	37.9	4.54	-
Methyl Carbitol	55.2	6.40	52
QR-681M	24.5	2.69	42
Amp-95	3.0	0.35	2
Triton CF-10	3.0	0.34	42
Drew L-405	2.7	0.39	14
Kadox 515	6.7	0.15	23
Red Oxide RO-8097	54.2	1.33	37
Atomite	76.5	3.39	49
MolyWhite 212	78.8	3.13	44
	Disperse and Let Down With		
Water	17.0	2.05	-
Rhoplex MV-23	551.1	62.83	42
Texanol	5.9	0.75	16
Aroplaz 1271 + Driers*	60.1	7.20	-
Sodium Nitrite - 13.8%	7.9	0.95	-
Drew L-493	3.4	0.48	14
QR-708	12.1	1.35	42
Total	1000.0	98.32	

* Aroplaz 1271	93.4%)		45
6% Cobalt Napthenate	0.5%)	Premix	48
6% Manganese Napthenate	0.5%)		48
6% Zirconium Napthenate	5.6%)		48

Weight per Gallon = 10.17 lbs

VOC = 326 gms/liter

2.7 lbs/gal

Appendix C-2

FORMULATIONS

No. S-6		Formulation No. P-21 Lbs	Gals	ICI Americas Supplier
Water	)	39.0	4.68	-
Colloids 642	)	1.0	0.14	7
Methocel J12-MS-2.5%	) Premix	80.0	9.60	13
Pluronic F-87-30%	)	7.0	0.83	30
Zinc Phosphate 317		57.0	2.10	40
Barytes No. 1		163.0	4.45	37
Red Oxide RC 1475		26.0	0.65	40
Colloids 642		1.0	0.14	7
		Disperse to 4-5 Heg. Let Down With		
Haloflex 202		592.0	55.33	35
Ammonia (28%) - to pH4		-	-	-
		Then add		
Pluronic F-87-30%		24.0	2.85	30
Texanol		10.0	1.27	16
	Total	1000.0	82.04	

Weight per Gallon = 12.19 lbs

VOC = gms/liter
lbs/gal

Appendix C-2

FORMULATIONS

No. S-7	Formulation 191		Polyvinyl Chemical
	Lbs	Gals	Supplier
NeoCryl A-622	334.5	39.21	38
Tamol SG-1	10.5	1.10	42
Triton CF-10	3.7	0.42	42
Colloid 643	2.2	0.31	7
Zopaque RCL-9	70.6	2.07	21
Yellow Iron Oxide 22880	47.0	1.40	37
Zinc Phosphate #317	45.2	1.73	40
Nytal 400	89.2	3.75	53
Atomite	64.8	2.88	49
	Disperse and Let Down With		
NeoCryl A-622	147.5	17.30	38
Water	115.8	13.88	-
	Premix and Add		
Epotuf 38-690	55.5	6.60	41
Ammonium Hydroxide - 28%	6.9	0.92	-
	Add		
Ammonium Benzoate - 10%	6.6	0.78	-
Total	1000.0	92.35	

Weight per Gallon = 10.83 lbs

VOC = 264 gms/liter

2.2 lbs/gal

Appendix C-2

FORMULATIONS

No. S-8	Formulation 14JG-74A		Union Carbide
	Lbs	Gals	Supplier
Water	242.1	29.07	-
Cellosize QP-15000	3.9	0.34	52
KTPP	1.0	0.10	46
Tamol 850	5.9	0.68	42
Ethylene Glycol	29.3	3.12	52
Dalpad A	11.7	1.27	22
Dibutyl Phthalate	7.8	0.88	52
Igepal CO-630	2.9	0.29	20
Drew XPD-11-043-2	9.7	0.98	14
Balab 748	2.0	0.26	55
Dowcil 75	1.5	0.10	13
TiPure R-960	146.4	4.39	15
Nalzin SC-1	97.6	2.93	34
	Disperse and Let Down With		
UCAR 4358	344.5	39.75	52
Balab 748	1.0	0.13	55
Water	92.7	11.14	-
Total	1000.0	95.43	

Weight per Gallon = 10.48 lbs

VOC = 56 gms/liter

0.5 lb/gal

Appendix C-3

FORMULATIONS

Sources of Raw Materials

1. Air Products & Chemicals
2. Angus Chemical Corp.
3. Buckman Laboratories
4. Byk Mallinkrodt
5. Cargill, Inc.
6. Celanese Polymer Specialities Co.
7. Colloids, Inc.
8. Columbian Chemical Co.
9. Cyprus Industrial Minerals
10. Frank D. Davis Co.
11. Degussa Corp.
12. Diamond Shamrock Corp.
13. Dow Chemical Corp.
14. Drew Chemical Corp.
15. E.I. duPont de Nemours & Co.
16. Eastman Chemical Products
17. Engelhard Minerals & Chemicals Corp.
18. English Mica Co.
19. Exxon, USA
20. GAF Corporation
21. Glidden & Durkee Division of SCM Corp.
22. W.R. Grace & Co.
23. G&W Natural Resources Group
24. Hammond Lead Products
25. Hercules, Inc.
26. Illinois Minerals Co.
27. International Minerals & Chemical Corp.
28. Interstab Chemicals, Inc.
29. Johns-Mansville Sales Corp.
30. BASF Wyandotte Corp.
31. Merck & Co.
32. Mineral Pigments Corp.
33. Mooney Chemicals, Inc.
34. NL Industries
35. ICI Americas, Inc.
36. C.J. Patterson Co.
37. Pfizer Corp.
38. Polyvinyl Chemical Industries
39. PVO International, Inc.

Appendix C-3

FORMULATIONS

Sources of Raw Materials

40. Reichard Coulston, Inc.
41. Reichhold Chemicals, Inc.
42. Rohm & Haas Co.
43. Ross & Rowe, Inc.
44. The Sherwin-Williams Co.
45. Spencer Kellogg, Division of Textron, Inc.
46. Stauffer Chemical Co.
47. Tammsco, Inc.
48. Tenneco Chemicals, Inc.
49. Thompson, Weinman & Co.
50. Troy Chemicals, Inc.
51. Ultra Adhesives, Inc.
52. Union Carbide Corporation
53. R.T. Vanderbilt Co.
54. Whittaker, Clark & Daniels, Inc.
55. Witco Chemical Corp.

Appendix D

Sources of Formulations or Primers

Company	Contact	Sample No.
Advanced Coatings & Chemicals 4343 Temple City Blvd Temple City, CA 91780		M-9 M-10
Buckman Laboratories, Inc. 1256 North McClean Blvd. Memphis, TN 38108	K.A. Haagenson Industry Specialist - Paint & Plastics	F-1
Cargill Research Dept. P.O. Box 9300 Minneapolis, MN 55440	A. Heitkamp Coatings Technology Service Laboratory	F-2
Celanese Chemicals & Specialties Co. 1065 West Hill Street P.O. Box 8248 Louisville, KY 40208	C.F. Dukes Business Manager - Coatings	F-14 F-15 F-16
DeVoe Marine Coatings Co. P.O. Box 7600 Louisville, KY 40207	V.J. Datta Product Line Manager	M-2 M-3 M-4 M-5
Fuller-O'Brien Division The O'Brien Corporation 450 East Grand Avenue South San Francisco, CA 94080	J. Lansingh Product Manager Metal Finishes	M-1
General Electric Co. Engineered Materials Group 305 Eastern Avenue Chelsea, MA 02150	J.M. Kelley Technical Service Specialist	M-8
Halox Pigments 1910 Cochran Road Pittsburgh, PA 15220	W.C. Spangenberg Vice President and General Manager	F-3 F-4

Appendix D (Cont)

Sources of Formulations or Primers

Company	Contact	Sample No.
ICI Americas Specialty Chemicals Div. P.O. Box 751 New Murphy Rd & Concord Pike Wilmington, DE 19897	W.P. Long Development Manager Product Development Dept.	S-6
Mineral Pigments Corp. 7011 Muirkirk Road Beltsville, MD 20705	M. Kaplan Technical Director	F-5
PVO International, Inc. 1145 South Tenth Street Richmond, CA 94804		F-7
Polyvinyl Chemical Industries 730 Main Street Wilmington, MA 01887	J.E. Fitzwater Technical Service Supervisor Coatings Products	S-7
Reichard-Coulston, Inc. 15 East 26th Street New York, NY 10010	C.W. Fuller	F-8 F-9
Rohm and Haas Co. Independence Mall West Philadelphia, PA 19105	D.M. Watson Market Manager Maintenance & Marine Coatings Polymers, Resins and Monomers	S-1 S-2 S-3 S-4 S-5
Sherwin Williams Co. A.W. Steudel Technical Center 549 East 115th Street Chicago, IL 60628	B. Delventhal Paint Chemist	M-6 M-7
Spencer Kellogg Div. of Textron, Inc. P.O. Box 210 4201 Genesee Street Buffalo, NY 14225	Dr. A. Ross Vice President, Research	F-10 F-11

Appendix D (Cont)

Sources of Formulations or Primers

Company	Contact	Sample No
Stanchem, Inc. 401 Berlin Street East Berlin, CT 06023	F.E. Flood Technical Director	M-11
Union Carbide Corp. Performance Chemicals & Polymers Division Garland, TX 75041	R.C. Pierrehumbert Senior Technical Specialist	S-8
Wet Ground Mica Association 60 Rock Harbor Road Orleans, MA 02653	Arnold J. Eickhoff Consultant	F-12 F-13

Appendix E

TEST PROCEDURE

Test methods developed by the American Society for Testing and Materials (ASTM) were used where possible.

1. Volatile Organic Compounds (VOC) — Unit-gms/liter or lbs/gal.

   ASTM D-3960 "VOC of Paints and Related Coatings"

2. Weight per Gallon — Unit - lbs

   ASTM D-1475 "Density of Paint, Varnish, Lacquer and Related Products

3. Total Solids — Unit - %

   ASTM D-2832 "Nonvolatile Content of Paint and Paint Materials"

4. Flash Point — Unit - °F

   ASTM D-93 "Flash Point by Pensky-Martens Closed Tester"

5. Viscosity — Unit - KU

   ASTM D-562 "Consistency of Paints Using the Stormer Viscometer"

   a) Heat Storage - 4 weeks at 125°F

      ASTM D-1849 "Package Stability of Paint"

   b) Freeze-thaw

      ASTM D-2243 "Freeze-Thaw Resistance of Latex and Emulsion Paints"

6. Storage Stability — Unit - Score

   ASTM D-1849 "Package Stability of Paint"

7. Drying Time — Unit - Hrs

   ASTM D-1640 "Drying, Curing or Film Formation of Organic Coatings at Room Temperature"

8. Sprayability — Unit - Score*

   Federal Standard TT-P-141B, Method 2141 "Application of Brushed Films"

9. Brushability — Unit - Score*

Federal Standard TT-P-141B, Method 2141 "Application of Brushed Films"

10. Adhesion — Unit - Score*

Federal Standard TT-P-141B, Method 6304 "Knife Test (Brittleness)"

11. Salt Fog Exposure

ASTM B-117 "Salt Spray (Fog) Testing"

a) Blistering — Unit - See below

ASTM D-714 "Evaluating Degree of Blistering of Paints"

Size			Concentration		
9	-	Very Small	F	-	Few
8	-	Small	M	-	Medium
6	-	Medium	D	-	Dense
4	-	Large			
2	-	Very large			

b) Corrosion — Unit - Score*

* Use ASTM Scoring Scheme as follows:

Score	Performance	or	Effect
10	Perfect		None
9	Excellent		Trace
8	Very good		Very slight
6	Good		Slight
4	Fair		Moderate
2	Poor		Considerable
1	Very poor		Severe
0	No value		Failed

Appendix F

CODE AND ABBREVIATIONS

A	-	Acceptable
ASTM	-	American Society for Testing and Materials test method
At X	-	At score mark cut thru the coating to expose the metal substrate
Dft	-	Dry film thickness
F	-	Failed
Gals	-	Gallons
gms/l	-	Grams per liter
hrs	-	Hours
KU	-	Krebs units
lbs/gal	-	Pounds per gallon
M	-	Marginal
Max.	-	Maximum
VOC	-	Volatile organic compounds
X	-	Not tested
xx	-	Minor property
%	-	Percent
°F	-	Degrees fahrenheit